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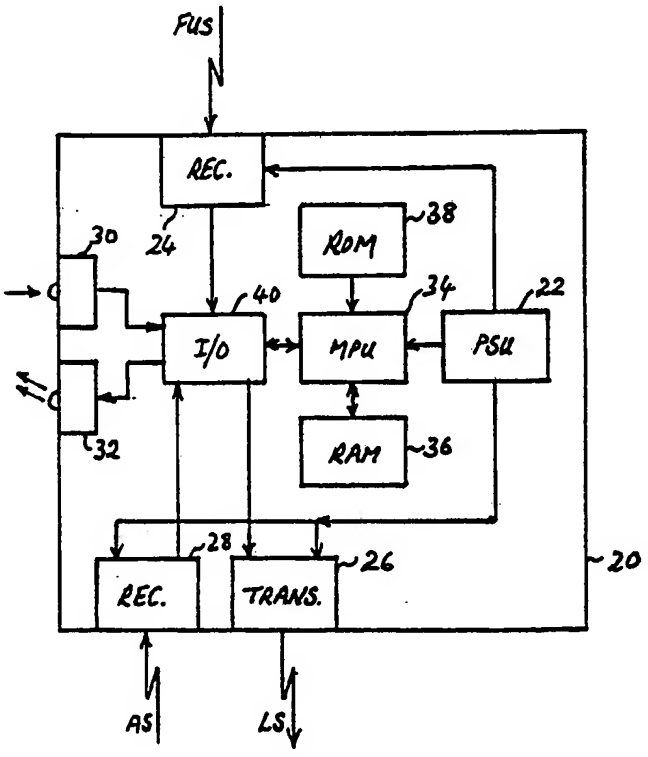
(54) Title: PERSONNEL LOCATION MONITORING SYSTEM

(57) Abstract

In a location monitoring system, a plurality of mutually spaced-apart fixed units (Fig. 1) are each capable of transmitting a wireless (e.g. microwave or infra-red) fixed unit signal (FUS), at least one mobile unit (Fig. 2) to be carried by a person is capable of detecting such a fixed-unit signal when in a limited region with respect to the fixed unit transmitting the signal, and a central unit (Fig. 3) receives a location signal (LS) from the or each mobile unit indicating which fixed unit was last detected by that mobile unit.



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PERSONNEL LOCATION MONITORING SYSTEM

This invention relates to a location monitoring system.

In sensitive environments, such as prisons or nuclear establishments, there is a need to be able to track personnel so that, in the event of an emergency, at least their approximate location can be determined. Because this needs to be done at least partly indoors, conventional range and direction finding equipment is unsuitable.

In accordance with one aspect of the present invention, there is provided a location monitoring system, comprising a plurality of mutually spaced-apart fixed units each capable of transmitting a wireless fixed unit signal (preferably a microwave and/or infra-red signal, but alternatively a magnetic or radio signal for example), at least one mobile unit to be carried by a person (for example in, or clipped to, their breast pocket) and capable of detecting such a fixed-unit signal when in a limited region (such as within 3 metres) with respect to the fixed unit transmitting the signal, a central unit, and means for transmitting a location signal from the or each mobile unit to the central unit indicating which fixed unit was last detected by that mobile unit.

Preferably, the fixed unit signal of each fixed unit is indicative of the identity of that fixed unit, and the location signal transmitting means is operable to transmit from the mobile unit to the central unit such a location signal indicative of the identity of the detected fixed unit. In the case where there is a plurality of such mobile units, preferably the location signal is also indicative of the identity of the respective mobile unit.

In one embodiment, the location signal is transmitted as a wireless signal (for example a radio signal) directly from the, or the respective, mobile unit to the central unit. In this case, the or each mobile unit is preferably operable to store the identity of at least the last detected fixed unit and optionally also the time of detection. The or each mobile unit preferably further comprises means operable by the person to cause the location signal to be transmitted. This may be used to contact the central unit in an emergency. In this case, the central unit may include means to transmit an acknowledgement signal in response to receipt of the location signal, and the or each mobile unit may include means to receive the acknowledgement signal caused by its

location signal and indicate the acknowledgement signal to the person. Additionally or alternatively, the or each mobile unit may comprise means to cause the location signal to be transmitted periodically. Also, additionally or alternatively, the central unit may be operable to transmit an interrogation signal, and the or each mobile unit may be operable to detect such an interrogation signal and to transmit the location signal in response thereto.

In another embodiment, the location signal may be transmitted as a wire-less signal (for example of the same type as the fixed unit signal) from the, or the respective, mobile unit to the fixed unit and relayed to the central unit, the location signal being indicative of detected fixed unit by virtue of which fixed unit relays the location signal. In this case, such a location signal may be transmitted each time a fixed unit is detected.

In accordance with another aspect of the present invention, there is provided a system for monitoring the location of a portable transmitting and receiving module in a given space, comprising a plurality of separated and fixed units (for example microwave units) each adapted to emit a beam limited to a specific region in space, and the portable module being adapted to be carried by a person and to detect the beam when in the region to cause the region to be identified and recorded.

A specific embodiment of the present invention and some modifications thereto will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a block diagram illustrating one of the fixed units;

Figure 2 is a block diagram illustrating a mobile unit; and

Figure 3 is a block diagram illustrating a central unit.

Referring to Figure 1, each fixed unit comprises a secure housing 10 having an external connection 12 to mains electricity which supplies a power supply unit 14 which may also include a back-up rechargeable battery. The power supply unit 14 energises a microwave or infra-red transmitter 16 and also a code generator 18. The code generator 18 produces a coded signal which is unique to the fixed unit in question and which modulates the transmitter 16, so that the signal FUS transmitted thereby is specific to that fixed unit.

A respective fixed unit is installed at each point to be

monitored. In a prison environment, fixed units would be installed, for example, above external doorways, above entrances to corridors, in narrow gaps between buildings, at a gate to a recreation field, and so on.

Each person to be monitored, for example each prison officer, is provided with a mobile unit, as shown in Figure 2, which is normally carried in or clipped to the breast pocket. Each mobile unit comprises a housing 20 containing a rechargeable battery 22, microwave or infra-red (as appropriate) receiver 24, radio transmitter 26 and receiver 28, switch 30, indicator 32, such as a light, and microprocessor comprising an MPU 34, with associated RAM 36, ROM 38 and I/O 40.

The MPU 34 is programmed by the ROM 38 to operate in part as follows. The output of the microwave/infra-red receiver 24 is monitored and when a fixed unit signal FUS is detected the identity code of the fixed unit generating the signal is stored in the RAM 36. Either the RAM 36 may store the identity code of the last detected fixed unit, or alternatively it may store the identity codes of the last two or more detected fixed units in the order in which they were detected. The mobile unit may also include a real time clock, and the time of detection of the fixed unit can then also be stored.

The power of the transmitters 16 in the fixed units and the sensitivity of the receivers 24 in the mobile units are selected so that each mobile unit only responds to a fixed unit when it is a predetermined distance therefrom, such as 3 metres.

Referring to Figure 3, the central unit comprises a microcomputer 50 comprising a CPU 52 with associated ROM 54, RAM 56 and I/O 58, a display 60, a keyboard 62, a radio receiver 64 and a radio transmitter 66.

The MPU 34 of each mobile unit is programmed by its ROM 38, and MPU 52 of the central unit is programmed by its ROM 54, to operate as follows. The state of the switch 30 of the mobile unit is monitored, and when depressed the radio transmitter 26 is enabled to transmit a location signal LS which includes a code (stored in the ROM 38) specific to the mobile unit in question and the identity code or codes (stored in the RAM 36) of the last detected fixed unit(s) and optionally also the time(s) of detection. In the central unit, the output of the receiver 64 is monitored, and when a location signal LS

is detected, the codes contained therein are decoded and displayed on the display 60 so as to identify the generating mobile unit and the last detected fixed units. Furthermore, an acknowledgement signal AS is transmitted by the transmitter 66 of the central station including the identity code of the generating mobile unit. Also, an alarm signal may be generated at the central station. The mobile units monitor the outputs of the receivers 28, and upon detection of an acknowledgement signal AS containing the code of the mobile unit in question, the indicator light 32 of that mobile unit is illuminated, thus indicating acknowledgement by the central unit.

In the case of a prison environment, it will be appreciated that as each prison officer passes a fixed unit, his mobile unit will be updated with the code of that fixed unit. In the event of an emergency, such as an attack on the officer, upon pressing the switch of his mobile unit, the central unit will be informed of the identity of the officer and at least the last fixed unit which the officer passed. Assistance can then be summoned by the operator of the central unit, and also the indicator light on the officer's mobile unit will be lit, assuming successful transmission, to reassure him that assistance should be on the way.

Various modifications, developments and refinements may be made to the system described above. For example, the fixed unit signals FUS may be other wire-less signals, such as radio signals or magnetic field signals. Also, instead of the identity code for each mobile unit being stored in its ROM 38, it may be stored in a personal identification key, such as a smart-card, which is specific to a particular user, and the personal identification key may be then inserted into any mobile unit and program that unit with the user's identity. In this case, rather than the alarm being raised by pressing a switch 30, the mobile units may operate such that removal of the personal identification key from the mobile unit serves the same purpose. Furthermore, instead of, or in addition to, the location signal LS being transmitted only upon operation of the switch 30 (or removal of the personal identification key), it may be transmitted periodically, or each time a fixed unit is detected, or in response to a coded interrogation signal sent from the central unit to the mobile unit. In this way, the central unit can be kept up to date as regards the approximate locations of all of the

mobile units. Additionally, instead of the location signals being transmitted directly from the mobile units to the central unit, they may be relayed via fixed relay units or the fixed units mentioned above. In the latter case, it may be unnecessary for the location signal transmitted from the mobile unit to the fixed unit to include the code of the fixed unit, provided that the central unit is able to determine from which fixed unit it is receiving a location signal. It will also be appreciated that, if the system described above is used with only one mobile unit, or if it is unnecessary to be able to distinguish one mobile unit from another, then the location signal need not include the code identifying the mobile unit. The fixed units may be anti-tamper protected and include a radio transmitter so that if a fixed unit is tampered with it can send an appropriate signal to the central unit. Although the central unit has been described above as a single unit, it will be appreciated that the receiver and transmitter may be near the area being monitored, whereas the remainder of the central unit may be at a remote location.

CLAIMS

1. A personnel location monitoring system, comprising:

a plurality of mutually spaced-apart fixed units (Fig. 1) each capable of transmitting a wire-less fixed unit signal (FUS);

at least one mobile unit (Fig. 2) to be carried by a person and capable of detecting such a fixed-unit signal when in a limited region with respect to the fixed unit transmitting the signal;

a central unit (Fig. 3); and

means for transmitting a location signal (LS) from the or each mobile unit to the central unit indicating which fixed unit was last detected by that mobile unit.

2. A system as claimed in claim 1, wherein each fixed unit signal is transmitted by a microwave and/or infra-red beam.

3. A system as claimed in claim 1, wherein each fixed unit signal is transmitted by a magnetic field or radio signal.

4. A system as claimed in any preceding claim, wherein:

the fixed unit signal of each fixed unit is indicative of the identity of that fixed unit; and

the location signal transmitting means is operable to transmit from the mobile unit to the central unit such a location signal indicative of the identity of the detected fixed unit.

5. A system as claimed in claim 4, and in the case where there is a plurality of such mobile units, wherein:

the location signal is also indicative of the identity of the respective mobile unit.

6. A system as claimed in claim 4 or 5, wherein:

the location signal is transmitted as a wire-less signal directly from the, or the respective, mobile unit to the central unit.

7. A system as claimed in claim 6, wherein:

the location signal is transmitted as a radio signal.

8. A system as claimed in claim 6 or 7, wherein:

the or each mobile unit is operable to store the identity of at least the last detected fixed unit.

9. A system as claimed in claim 8, wherein:

the or each mobile unit is operable to store the time of detection of at least the last detected unit.

10. A system as claimed in any of claims 6 to 9, wherein:

the or each mobile unit further comprises means (30) operable by the person to enable the location signal to be transmitted.

11. A system as claimed in claim 10, wherein:

the central unit includes means (66) to transmit an acknowledgement signal (AS) in response to receipt of the location signal; and

the or each mobile unit includes means (28,32) to receive the acknowledgement signal caused by its location signal and indicate the acknowledgement signal to the person.

12. A system as claimed in any of claims 6 to 11, wherein:

the or each mobile unit comprises means to cause the location signal to be transmitted periodically.

13. A system as claimed in any of claims 6 to 12, wherein:

the central unit is operable to transmit an interrogation signal; and

the or each mobile unit is operable to detect such an interrogation signal and to transmit the location signal in response thereto.

14. A system as claimed in any of claims 1 to 3, wherein:

the location signal is transmitted as a wire-less signal from the, or the respective, mobile unit to the fixed unit and relayed to the central unit, the location signal being indicative of detected fixed unit by virtue of which fixed unit relays the location signal.

15. A system as claimed in claim 14, wherein the location signal which is transmitted from the or each mobile unit to the fixed unit is of the same type as the fixed unit signal.

16. A system as claimed in any preceding claim, wherein:

such a location signal is transmitted each time a fixed unit is detected.

17. A system for monitoring the location of a portable transmitting and receiving module (Fig. 2) in a given space, comprising a plurality of separated and fixed units (Fig. 1) (for example microwave units) each adapted to emit a beam (FUS) limited to a specific region in space, and the portable module being adapted to be carried by a person and to detect the beam when in the region to cause the region to be identified and recorded.

AMENDED CLAIMS

[received by the International Bureau on 22 September 1992 (22.09.92); original claim 10 cancelled; original claims 1,11-13 and 16 amended; new claim 18 added, other claims unchanged (3 pages)]

1. A personnel location monitoring system, comprising:

a plurality of mutually spaced-apart fixed units (Fig. 1) each capable of transmitting a wire-less fixed unit signal (FUS);

at least one mobile unit (Fig. 2) to be carried by a person and capable of detecting such a fixed-unit signal when in a limited region with respect to the fixed unit transmitting the signal;

a central unit (Fig. 3); and

means operable by the person for transmitting an emergency location signal (LS) from the or each mobile unit to the central unit indicating which fixed unit was last detected by that mobile unit.

2. A system as claimed in claim 1, wherein each fixed unit signal is transmitted by a microwave and/or infra-red beam.

3. A system as claimed in claim 1, wherein each fixed unit signal is transmitted by a magnetic field or radio signal.

4. A system as claimed in any preceding claim, wherein:

the fixed unit signal of each fixed unit is indicative of the identity of that fixed unit; and

the location signal transmitting means is operable to transmit from the mobile unit to the central unit such a location signal indicative of the identity of the detected fixed unit.

5. A system as claimed in claim 4, and in the case where there is a plurality of such mobile units, wherein:

the location signal is also indicative of the identity of the respective mobile unit.

6. A system as claimed in claim 4 or 5, wherein:

the location signal is transmitted as a wire-less signal directly from the, or the respective, mobile unit to the central unit.

7. A system as claimed in claim 6, wherein:

the location signal is transmitted as a radio signal.

8. A system as claimed in claim 6 or 7, wherein:

the or each mobile unit is operable to store the identity of at least the last detected fixed unit.

9. A system as claimed in claim 8, wherein:

the or each mobile unit is operable to store the time of detection of at least the last detected unit.

11. A system as claimed in any of claims 6 to 9, wherein:

the central unit includes means (66) to transmit an acknowledgement signal (AS) in response to receipt of the location signal; and

the or each mobile unit includes means (28,32) to receive the acknowledgement signal caused by its location signal and indicate the acknowledgement signal to the person.

12. A system as claimed in any of claims 6 to 11, wherein the transmitting means of the or each mobile unit is operable to transmit periodically a location signal indicating which fixed unit was last detected by that mobile unit.

13. A system as claimed in any of claims 6 to 11, wherein:

the central unit is operable to transmit an interrogation signal; and

the transmitting means of the or each mobile unit is operable to detect such an interrogation signal and to transmit a location signal in response thereto indicating which fixed unit was last detected by that mobile unit.

14. A system as claimed in any of claims 1 to 3, wherein:

the location signal is transmitted as a wire-less signal from the, or the respective, mobile unit to the fixed unit and relayed to the central unit, the location signal being indicative of detected fixed unit by virtue of which fixed unit relays the location signal.

15. A system as claimed in claim 14, wherein the location signal which is transmitted from the or each mobile unit to the fixed unit is

of the same type as the fixed unit signal.

16. A system as claimed in any preceding claim, wherein the transmitting means is operable to cause a location signal to be transmitted each time a fixed unit is detected.

17. A system for monitoring the location of a portable transmitting and receiving module (Fig. 2) in a given space, comprising a plurality of separated and fixed units (Fig. 1) (for example microwave units) each adapted to emit a beam (FUS) limited to a specific region in space, and the portable module being adapted to be carried by a person and to detect the beam when in the region to cause the region to be identified and recorded.

18. A personnel location monitoring system, comprising:

a plurality of mutually spaced-apart fixed units (Fig. 1) each capable of transmitting a wire-less fixed unit signal (FUS);

at least one mobile unit (Fig. 2) to be carried by a person and capable of detecting such a fixed-unit signal when in a limited region with respect to the fixed unit transmitting the signal;

a central unit (Fig. 3); and

means for transmitting a location signal (LS) from the or each mobile unit to the central unit indicating which fixed unit was last detected by that mobile unit.

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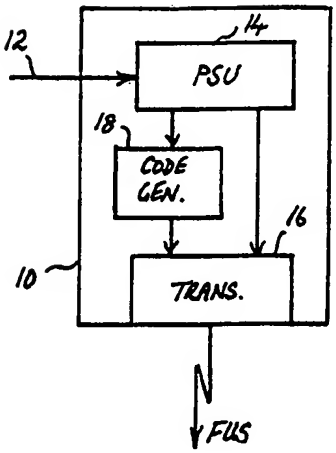

FIG.1

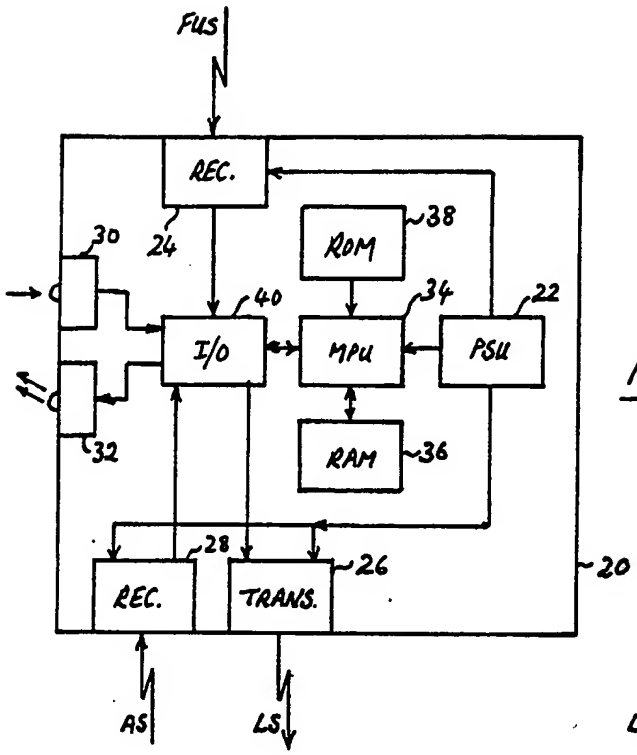

FIG.2

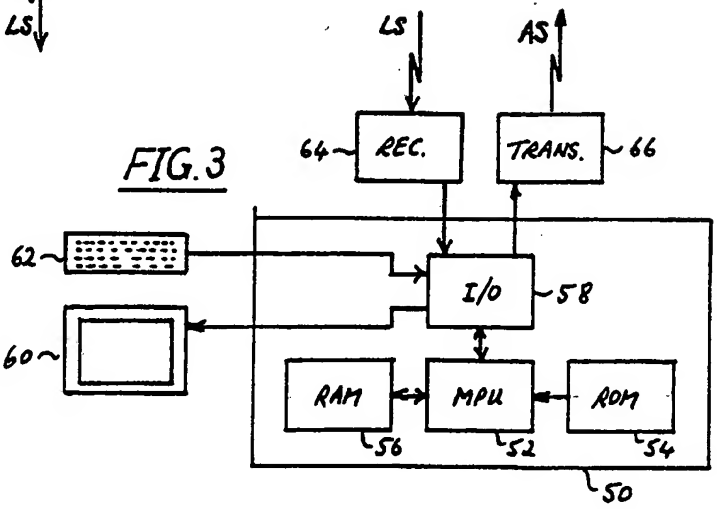

FIG.3

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 92/00653

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 G08B3/10

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G08B ; G08G

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	EP,A,0 372 640 (ERICSSON PAGING SYSTEMS) 13 June 1990 see the whole document	1-10,17
A	---	13
X	US,A,3 984 807 (A. HAEMMIG) 5 October 1976 see column 1, line 40 - column 2, line 46	1-11
A	---	16
X	US,A,4 275 385 (L. WHITE) 23 June 1981 see column 2, line 30 - line 50	1-3, 14-15
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X	US,A,3 739 329 (R. LESTER) 12 June 1973 see abstract	1-3, 14-15

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
17 JULY 1992	23. 07. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	SGURA S.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9200653 SA 58298

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 17/07/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0372640	13-06-90	NL-A- 8802989 EP-A- 0372633	02-07-90 13-06-90
US-A-3984807	05-10-76	US-A- 4083003	04-04-78
US-A-4275385	23-06-81	None	
US-A-3739329	12-06-73	None	